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THE OCCURRENCE OF UNUSUALLY LARGE BOWLDERS IN GRAVEL DEPOSITS.

By JOHN L. RICH.

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Art. XXXVI.—*The Occurrence of Unusually Large Bowlders in Gravel Deposits;* by John L. Rich.*

Various observers, particularly in western United States, have described the occurrence of very large bowlders embedded in the finer material of piedmont gravel deposits, some of them in such situations that their transportation thither is difficult to explain.† In some cases the great size of the bowlders and their situation with respect to their nearest possible source is such as to render almost incredible the idea of their having been transported by running water, in spite of the well-known fact that the transporting power of torrential streams is very great. In such cases the temptation is sometimes strong to invoke the aid of glacial ice as the only agent capable of having performed the task.

Fig. 1.

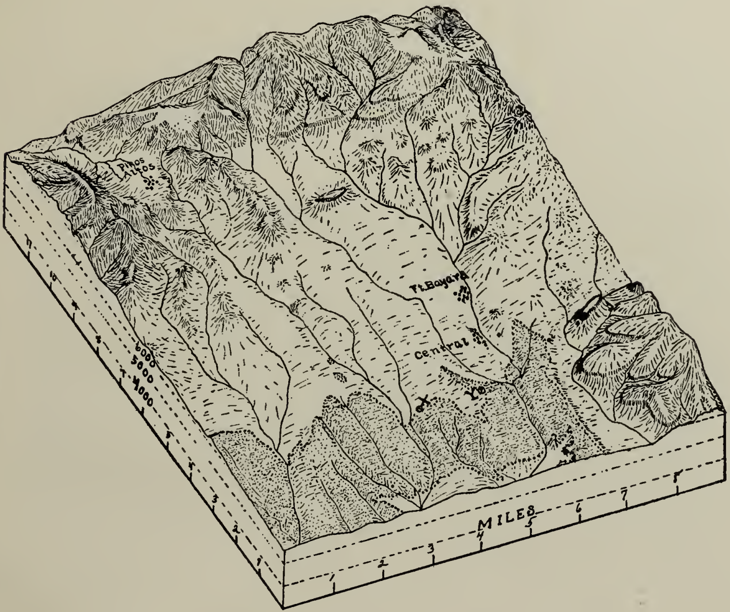

Fig. 1. Block diagram illustrating general relations of various features described. Dotted area is gravel. On the right is the eastern escarpment, the nearest possible source for the large bowlders at X and Y.

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* Published by permission of the Director of the U. S. Geological Survey.

† See references following; also Trowbridge, A. C., Jour. Geol., xix, 706-47, 1911. Capps and Leffingwell, Jour. Geol., xii, 702, 1904.

An occurrence of such bowlders in a desert gravel deposit 6 miles east of Silver City, New Mexico, happens to be so related to surrounding topographic features that a clue as to a possible mode of accumulation independent of water or ice presents itself. The belief that the explanation suggested for this particular occurrence is one of general application where topographic conditions are favorable, and should be considered and eliminated before resort to glacial ice, even in the neighborhood of glaciated mountains, leads me to present a description of the bowlders, in relation to their surroundings, together with an outline of the proposed explanation of their origin.

Fig. 2.

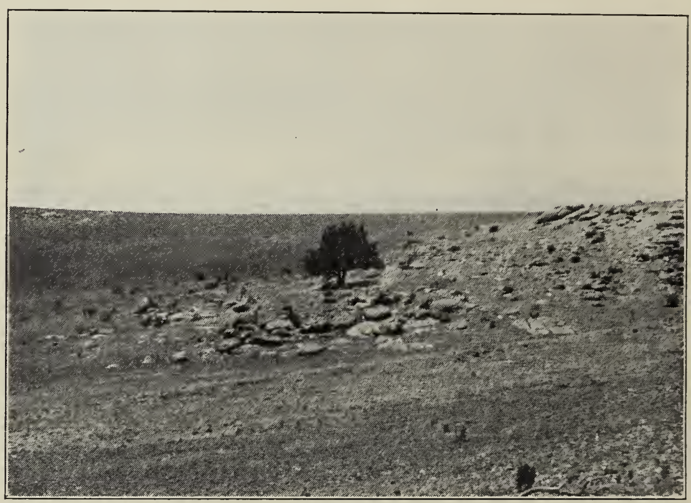

Fig. 2. Nests of large bowlders in piedmont gravels (at Y, fig. 1). The size of the bowlders in the group in the foreground may be judged by comparison with the cattle. A second "nest" lies in the background to the left.

The location of the masses of bowlders in question with respect to the gravel deposit in which they lie, and of this to surrounding higher lands, is indicated on the accompanying block diagram (fig. 1) constructed from the Silver City, N. M. Sheet, U. S. G. S. (see also Silver City Folio, U. S. G. S., soon to be published). The gravels constitute the partially dissected northern and mountainward edge of an extensive piedmont alluvial plain, continuous toward the south with a series of great waste-filled basins which make up a considerable part of southern New Mexico, but separated on the north from its parent high lands by a gravel-free lowland, 3 to 5 miles in width, developed to old age on shales and intrusives of moderate resistance. From the highlands on the east it is separated by a relatively narrow valley. The gravel plain faces the lowland to the north as a low, irregular escarpment 50 to 100 feet in height.

On the northwestern border of the lowland, near Pinos Altos, stands a group of conical peaks of intrusive rocks. Bounding it on the north and northeast, and running in a direction a little south of east, is a great, sub-maturely dissected escarpment of flat-lying lavas—rhyolites at the base and basalts above—rising 1500 to 2500 feet above the general level of the lowland. On the east of both lowland and piedmont gravel plain stands a similar escarpment of lesser height, capped mainly by rhyolite, overlying thick and relatively weak gravels and tuffs. A temporary stream at the base of this escarpment keeps it sharp in outline, and continually retreating.

Fig. 3.

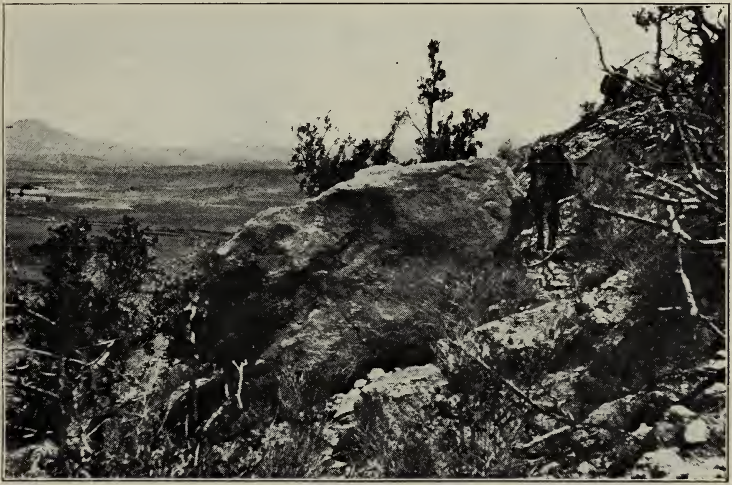

Fig. 3. One of the large bowlders in the group at X (fig. 1). Note size in comparison with the horse. In middle ground is the gravel-free inner lowland between the gravel plain and the mountains which appear in the background.

The large bowlders under discussion lie at or near the northern edge of the gravel plain (at X and Y, fig. 1) and in the upper part of the gravels, 100 feet and more above the level of the streams which dissect them.

The bowlders, which so far as observed are rhyolites like those forming the escarpments to the east and the base of that to the north, occur in groups or nests of many individuals, lying close together. Three such groups, two of which appear in fig. 2, were noted. Doubtless others might be found.

One of the bowlders in place in the gravels measured 15 feet in length and 4 feet in thickness for the exposed part. How much thicker or how wide the bowlder was could not be determined. Twenty feet away, but not exactly in place lay another (fig. 3), which measured roughly 15 feet in diameter and from 6 to 9 feet in thickness. Others of smaller size lay nearby.

The cattle shown in fig. 2 indicate by comparison the size of the bowlders there exposed.

The matrix in which they lie is a desert conglomerate of medium to fine texture, the components ranging for the most part from 1-8 inch to one foot in diameter—the finer material predominating. The nearest highland from which the bowlders could have come is the escarpment to the east, 2 or 3 miles away and separated from the gravel plain by the half-mile wide valley of Whitewater Creek. Another possible source is the escarpment to the north 6 to 7 miles away, across the intervening lowland.

It might be argued, and possibly correctly, that the bowlders were carried to their present position by torrential streams before the development of the lowland, and when the escarpment stood nearer; or it might be argued that the gravels must be of glacial origin. The latter, however, clearly is not the correct explanation of this case, for there are no evidences of former glaciation in the region.

The possible explanation of the phenomenon which the writer would propose, and which seems to him the most satisfactory, is that the bowlders may have rolled down to their present position as landslides, or rockslides, from one or another of the escarpments (probably that to the east) when it stood near where the bowlders now lie. The retreat of escarpments by sapping and landsliding is too well known to require explanation. These escarpments are *now* retreating, and they must have retreated in the past. So far as it is known the geological evidence is in accord with the hypothesis that the scarp-forming lavas once covered the area now occupied by the lowland and by the part of the gravel plain where the bowlders lie.

The clue to the explanation outlined above presented itself when it was observed that huge bowlders, similar in size to those in the gravels, lie either singly or in groups at the base of the present eastern escarpment where they have rolled or slid down from the cliffs above. It is conceivable that under an aggradational regimen of Whitewater Creek these bowlders might become buried in gravels as the others seem to have been, and further retreat of the escarpment might leave them buried far out on a gravel plain.

Bowlders rolled or slid into position in this way might in some cases exhibit striation, and thus lead still further astray the geologist inclined to look upon them as of glacial origin.

If one may judge from the published descriptions, without having been on the ground, some of the so-called older drift of the San Juan region described by Cross and Howe and others* may be susceptible of an alternative interpretation similar to that outlined above.

Several of the deposits in question occur in or at the margins of desert gravel plains; they are marked by enormous bowlders, in many cases without undoubted glacial striations; they are so situated with respect to high scarps of flat-lying lavas as to be within the area probably once covered by those lavas and therefore within the areas of possible landsliding from the scarps; and finally, at the base of the present scarps are extensive masses of landslide debris, in many respects resembling the so-called old drift, which may on further retreat of the scarps come to occupy a similar position.

In view of these considerations, it seems hazardous to assign to a bowlder-bearing deposit a glacial origin until the alternative outlined above has been specifically considered and positively eliminated.

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*U. S. Geol. Survey, Folio 153, Rico, Colo. Cross and Howe, Bull. Geol. Soc. Am., xvii, 251-74, 1906. Hole, A. D., Jour. Geol., xx, 710-37, 1912. Atwood, W. W., Jour. Geol., xx, 385-409, 1912.

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